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PATENT AND TECHNICAL TRANSLATION

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DECLARATION

The undersigned, Olaf Bexhoeft, hereby states that he is well acquainted with both the English and German languages and that the attached is a true translation to the best of his knowledge and ability of the German text of PCT/EP2005/051162, filed 03/15/2005, and published on 10/06/2005 as WO 2005/094054 A1 and of nineteen (19) amended claims.

The undersigned further declares that the above statement is true; and further, that this statement was made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any patent resulting therefrom.

Olaf Bexhoeft

Specification

Method for the Early Identification of a Deviation in the Printed Images that have been Created by a Printing Press during Continuous Production

The invention relates to a method for the early detection of a deviation in printed images created by a printing press during an ongoing production in accordance with the preamble of claim 1.

Printed images created by a printing press have been checked for a considerable time for their respective quality by the operators of printing presses. A classification of the printed images into good or poor quality is performed in the course of this, i.e. the printed image of these printed products is classified as being either good or poor, i.e. containing errors.

Furthermore, a method for detecting and controlling the quality of printed products, in particular during the printing process, is known from DE 40 23 320 A1, wherein an evaluation of each sheet takes place in a primary phase, which assigns the classification "good" or "poor" to each sheet, wherein after the detection of a sheet containing an error, in a secondary phase three actual color images are additionally employed with the aid of an expert system for the determination of the type of error, wherein an alarm signal is triggered if a preset number of sheets with errors is exceeded.

A method for comparing the printed image of detected images with a reference image is known from DE 199 40 879 A1, wherein the

images to be compared are digitized in the form of pixel data and stored.

The invention is based on the object of creating a method for the early detection of a deviation in printed images created in a printing press in the course of an ongoing production.

In accordance with the invention, this object is attained by means of the characteristics of claim 1.

The advantages to be obtained by means of the invention consist in particular in that a slowly accumulating error in an ongoing printing process can be detected early and its cause can be removed by the operators by countermeasures which are performed manually or in an automated way, before the quality of the printed products assumes a state which would be classified as poor and the printing process would result in a production of printed products which contain errors and cannot be sold. The decision threshold which is provided in addition to a decision regarding a good or poor print quality makes it possible that a slight deviation from printed images being created in the ongoing printing process, which is still inside a tolerance range, is signaled before this deviation builds up into a critical error. Because of this it is possible to take suitable countermeasures early on without this deviation resulting in a production of printed products of poor quality. Moreover, the possibility for a separate adjustment of the warning threshold and the error threshold has the particular advantage that a distance between these two decision thresholds can be matched to the requirement of the respective production by the operators, since it may be necessary in connection with different printed products to set their permissible print deviations differently within defined tolerances, because the quality requirements of these different printed products which

have been produced on the same printing press are different from each other.

An exemplary embodiment of the invention is represented in the drawings and will be described in greater detail in what follows.

Shown are in:

Fig. 1, a schematic representation of an inspection system,

Fig. 2, a two-dimensional representation of a pixel field,

Fig. 3, a reference image with minimum and maximum values for each pixel,

Fig. 4, a comparison of the actually recorded print image with a reference image,

Fig. 5, a representation of the evaluation of the deviation from the reference image by means of two decision thresholds.

In accordance with a schematic representation of an inspection system in Fig 1, an inspection system which is particularly suited for checking a printed image has one or several line-scanning color cameras 01, which are coupled with each other, or an area-scanning color camera 01, which records a printed image 03, which is illuminated by an illumination arrangement 02, wherein the printed image 03 has been generated by a printing press on an imprinted material consisting, for example, of paper. Amplitude values Axy of the individual color channels, which have been created from the recording of the image by the line-scanning color camera 01 or area-scanning color camera 01, are calculated in an image processing system 04. Output of the results is provided, for example, on a monitor 06 connected with the image processing system 04. Inputs, for example of parameters of which the image processing system 04 needs to be informed for

its calculations, are entered via a keyboard 07 connected to the image processing system 04.

In the course of a learning phase during a production which has been classified as good, the image processing system 04 uses the amplitude values Axy from the line-scanning color camera 01 or the area-scanning color camera 01 to compute a reference image.

Fig. 2 shows a two-dimensional representation of a pixel field, for example a square one, resulting from the representation of the printed image, wherein the basic surface of the pixel field consists, for example, of 8 x 8 pixels, and the amplitude values Axy of the pixel field have been applied to its upward ordinate axis. For reasons of simplicity, in what follows the data taken or derived from the pixel field will only be represented for a one-dimensional area of a single line of, for example, eight pixels i, wherein i = 0 to 7.

Fig. 3 shows a reference image, preferably generated from several recordings, with the respective maximum values Aimax and minimum values Aimin of each pixel i. Subsequently the amplitude values Aip of the actually recorded printed image are compared with this reference image consisting of the course of the respective maximum values Aimax and minimum values Aimin and the deviations are determined, such as is shown in Fig. 4. In the course of the comparison of the amplitude values Aip of the actually recorded printed image with its reference image the contrast AK with the reference image in particular is evaluated for each deviation.

The determination of the deviation between the actually recorded printed image and the reference image takes place via two decision thresholds W and F, which must be set separately, wherein one decision threshold forms a warning threshold W and the other

decision threshold an error threshold F (Fig. 5). In this way each one of the decision thresholds can be set independently of the respectively other one. As soon as the deviation, i.e. in particular the contrast AK with the reference image, for one or several pixels i lies above the warning threshold W, but still below the error threshold F, a warning is issued for this image area. As soon as the deviation, i.e. in particular the contrast AK with the reference image, for a pixel i lies above the error threshold F, this image area is rated as an error. Therefore the difference between a warning and an error takes place by means of the amount of the deviation in regard to the learned reference.

In addition, a further evaluation can take place by means of the number of warnings or errors in regard to pixels i in a local neighborhood. If, for example, only a single pixel i deviates from the learned reference, this is a warning or an error of small size or importance and can possibly be neglected. For this reason consideration of the size or importance of the warning and/or of the error is subsequently taken, wherein a check is made in the course of this consideration whether, for example in an 8 x 8 pixel field, several pixels i stand out of the reference in close vicinity and together result in a larger deviation in regard to the area. In this way it is possible to determine not only a deviation, i.e. in particular the contrast AK as such, but also an area in which a deviation from the learned reference image exists, and this area can be set in respect to its decision thresholds W and F. The number of deviations in the evaluated area, starting at which either a warning or an error is generated or displayed, can be determined by means of adjustable threshold values W and F.

So that during this examination errors of a high contrast AK, but small size, are not being missed, the area above the error

threshold F is also determined. If in the course of this an adjustable value, a so-called error weight FG, is exceeded in a local area of, for example, 8 x 8 pixels, an error is reported regardless of the deviation of the area of the deviation in the contrast AK.

The display of deviations takes place at the monitor 06, for example separated as to the type of deviation, preferably in different colors, wherein preferably the display on the monitor 06 is superimposed positionally accurate on the actual printed image.

During an ongoing production of the printing press, by means of this the operator is placed into a position of detecting immediately in which printing group the reason for a deviation in quality of the printed product occurs. It is then possible to evaluate the reason and to correct it.

List of Reference Numerals

01	Line-scanning color camera, area-scanning color camera
02	Illumination arrangement
03	Printed image
04	Image processing system
05	-
06	Monitor
07	Keyboard

Axy	Amplitude value
Aimax	Maximum value
Aimin	Minimum value
Aip	Amplitude value
AK	Contrast
F	Error threshold
FG	Error weight
i	Pixel
W	Warning threshold